



Airspace Technology Demonstration 2 (ATD-2)

ATD-2 CLT Pilot Community Engagement

Feb 23, 2017

Al Capps, Al.Capps@nasa.gov, (817) 858-7779
Becky Hooey, Becky.L.Hooey@nasa.gov (650) 604-2399

Time	Event	Presenter
0800	Opening Remarks and Introductions	Shawn Engelland
0830	ATD-2 Background and Context	Al Capps
0915	Current Operations and ATD-2 Solutions Primer	Becky Hooey
1000	Break	Break
1015	Phase 1 Procedures, Training expectations	Becky Hooey
1200	Lunch	Lunch
1300	Phase 1 Procedures, Training expectations (cont.)	Becky Hooey
1430	Future Opportunities to Engage. Q&A	Al Capps
1445	Break	Break
1500	Research on Integrated Mobile Technology	FAA/MITRE

- Introduce ATD-2 to the CLT pilot community
- Describe likely areas of procedural change (and benefit) to current day CLT procedures in ATD-2 Phase 1
- Identify ATD-2 representatives from each organization
- Describe opportunities for future engagement
- Survey data elements and capability pilots may desire in later phases of ATD-2

Time	Event	Presenter
0800	Opening Remarks and Introductions	Shawn Engelland
0830	ATD-2 Background and Context	Al Capps
0915	Current Operations and ATD-2 Solutions Primer	Becky Hooey
1000	Break	Break
1015	Phase 1 Procedures, Training expectations	Becky Hooey
1200	Lunch	Lunch
1300	Phase 1 Procedures, Training expectations (cont.)	Becky Hooey
1430	Future Opportunities to Engage. Q&A	Al Capps
1445	Break	Break
1500	Research on Integrated Mobile Technology	FAA/MITRE



ATD2



Charlotte-Douglas[®]
INTERNATIONAL AIRPORT

American Airlines





PREDICTABILITY



AIRCRAFT MOVEMENT
EFFICIENCY

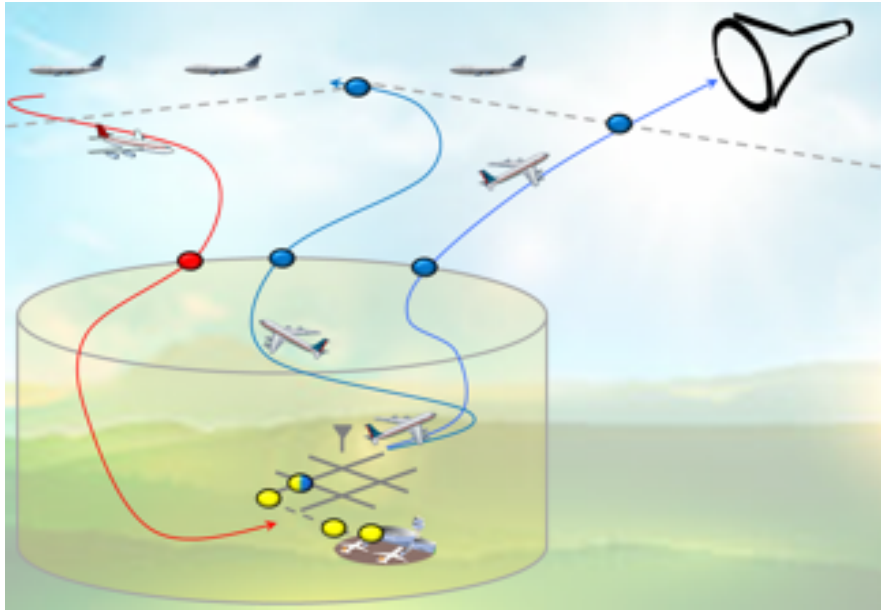


DELAYS



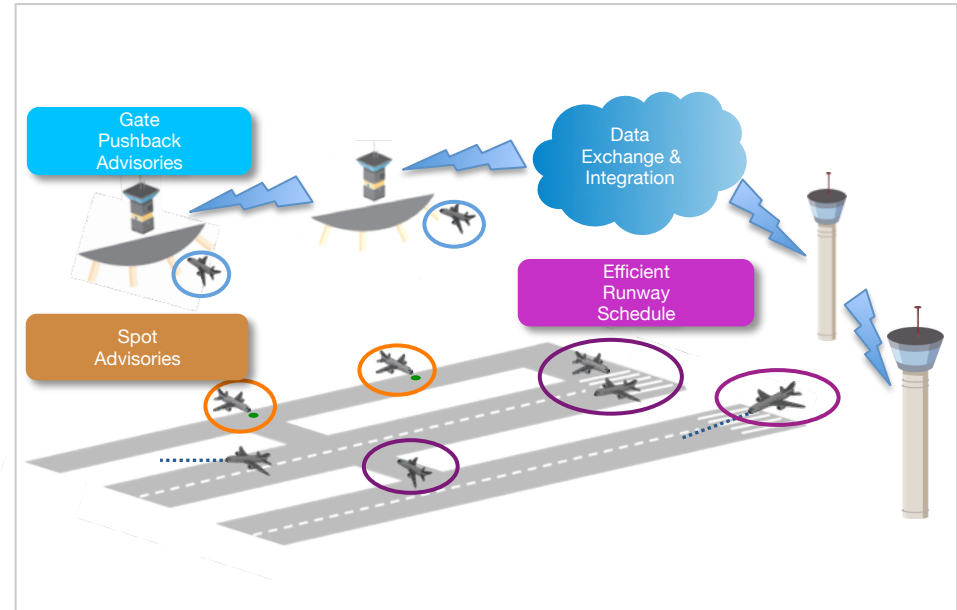
FUEL USAGE





3T Data Exchange & Integration

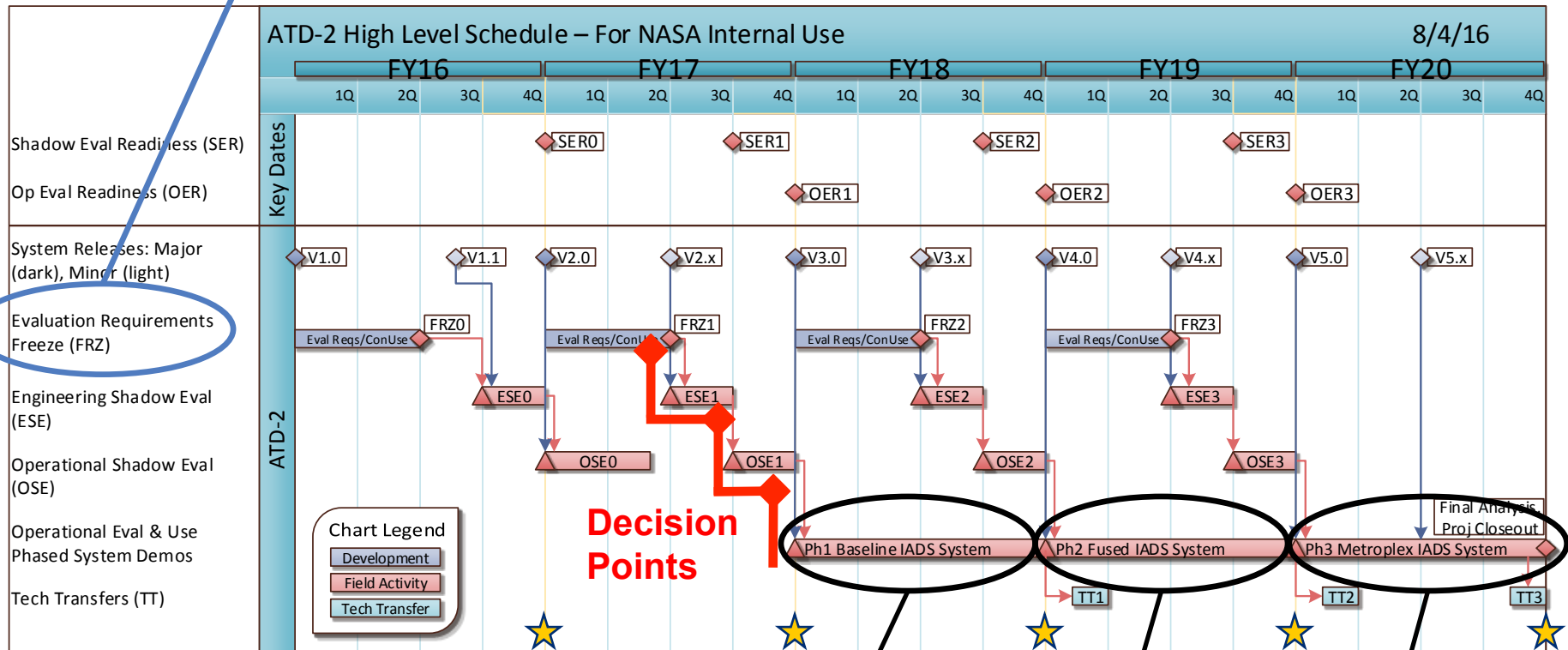
- Integrated Arrival/Departure/Surface (IADS) footprint
- Onboard into overhead stream (TFDM with IDAC)
- New data shared between FAA & Industry
- TFDM Electronic Flight Data (EFD) integration
- Real-time dashboard for situational awareness
- Use of controller assigned runway and time on surface



Surface modeling, scheduling & metering

- Trajectory based model of airport operations
- Latest predictions of flight scheduled out/off/on/in
- Scheduling for tactical and strategic timeframes
- Surface Collaborative Decision Making (S-CDM)
- Predictive capacity estimation technology

Evaluation Requirements Freeze (FRZ) assesses current system capability against Field Demo Partner desires and constraints. A joint decision establishes parameters for the upcoming demonstration phase.



Commitments to Demo Partners

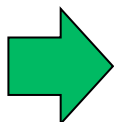
- Sep 2016 ATD-2 system installation at CLT
- Sep 2017 ATD-2 demonstration commences
- Sep 2018 interim technology transfer
- Sep 2019 interim technology transfer
- Sep 2020 final technology transfer

Phase 1: Baseline IADS

Phase 2: Fused IADS

Phase 3: Metroplex IADS

Today's
Focus



Procedures, Roles and Responsibilities

Surface Metering

Surface Scheduling

Surface Modeling

Departure
Reservoir
Management

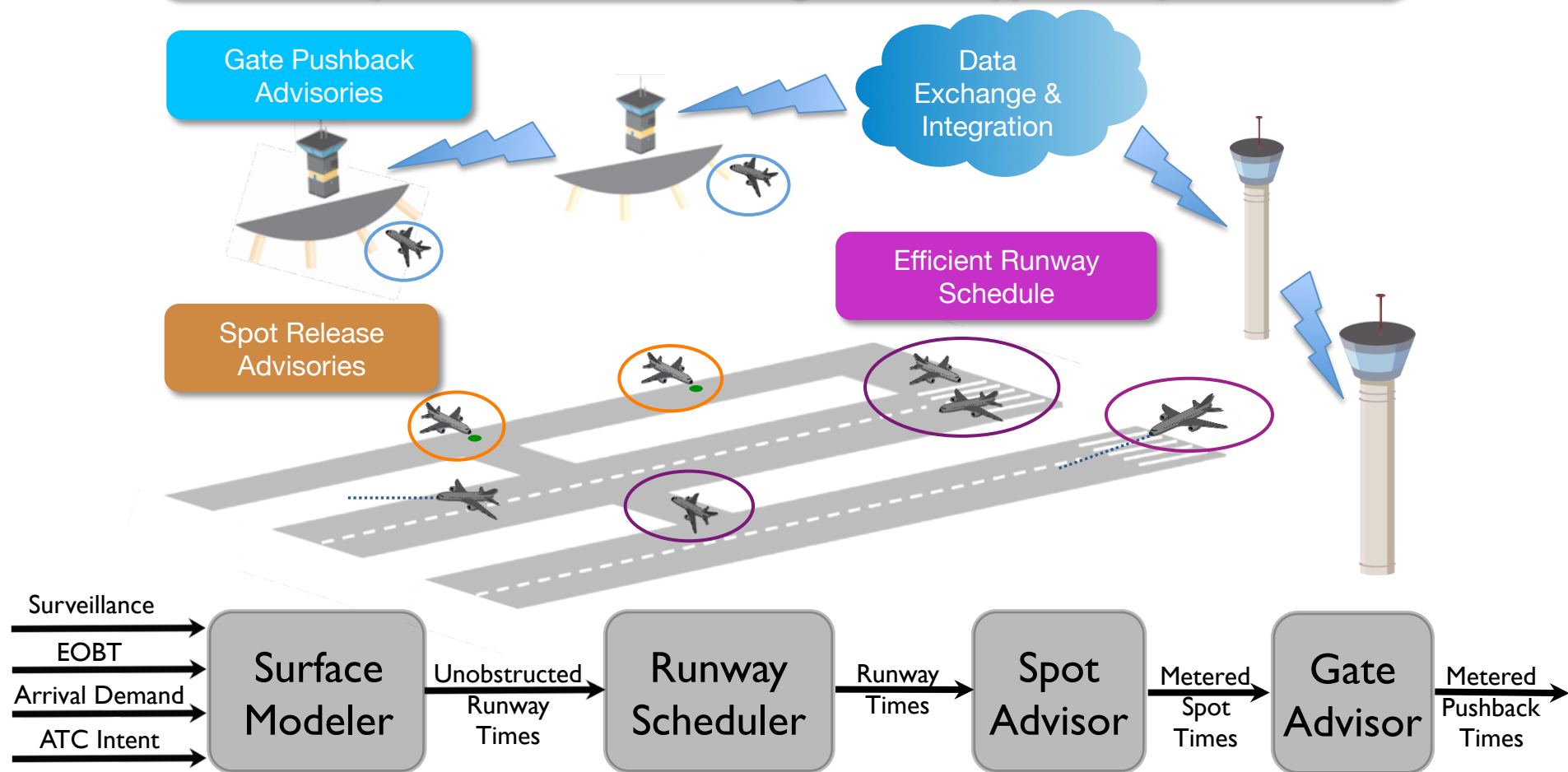
Surface Surveillance

Data Exchange and Integration

Tactical Surface Metering Concept



- Estimates capacity of current and future runway resources
- Builds an efficient runway schedule based on readiness, EOBT and RBS
- Calculates spot advisories that support the metered runway schedule
- Provides push back advisories from gates that support the spot advisories



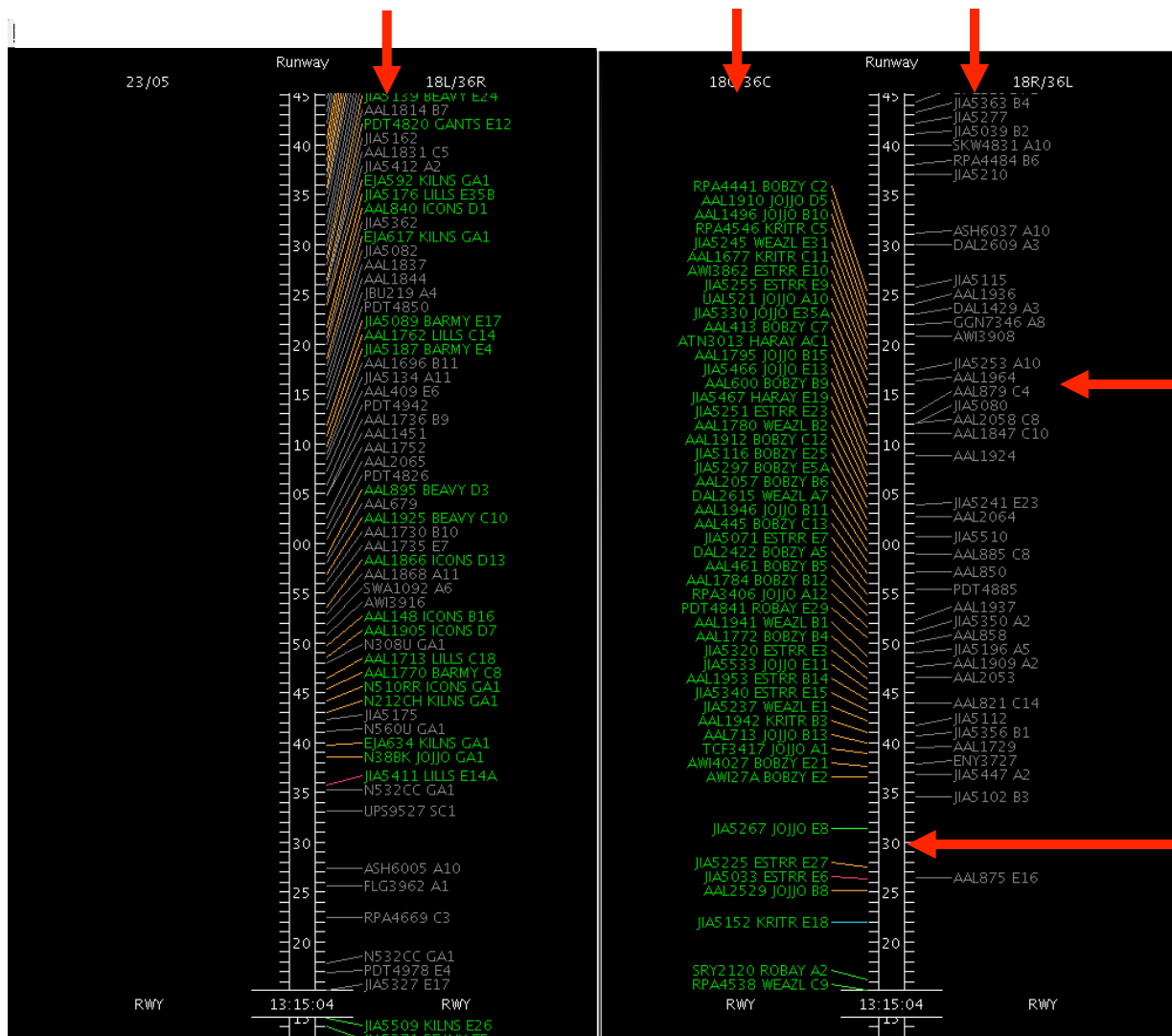
Capacity- CLT Runway Utilization Example Heavy West Bank



East side, mix of arrivals
and departures on 18L

West side
Departures

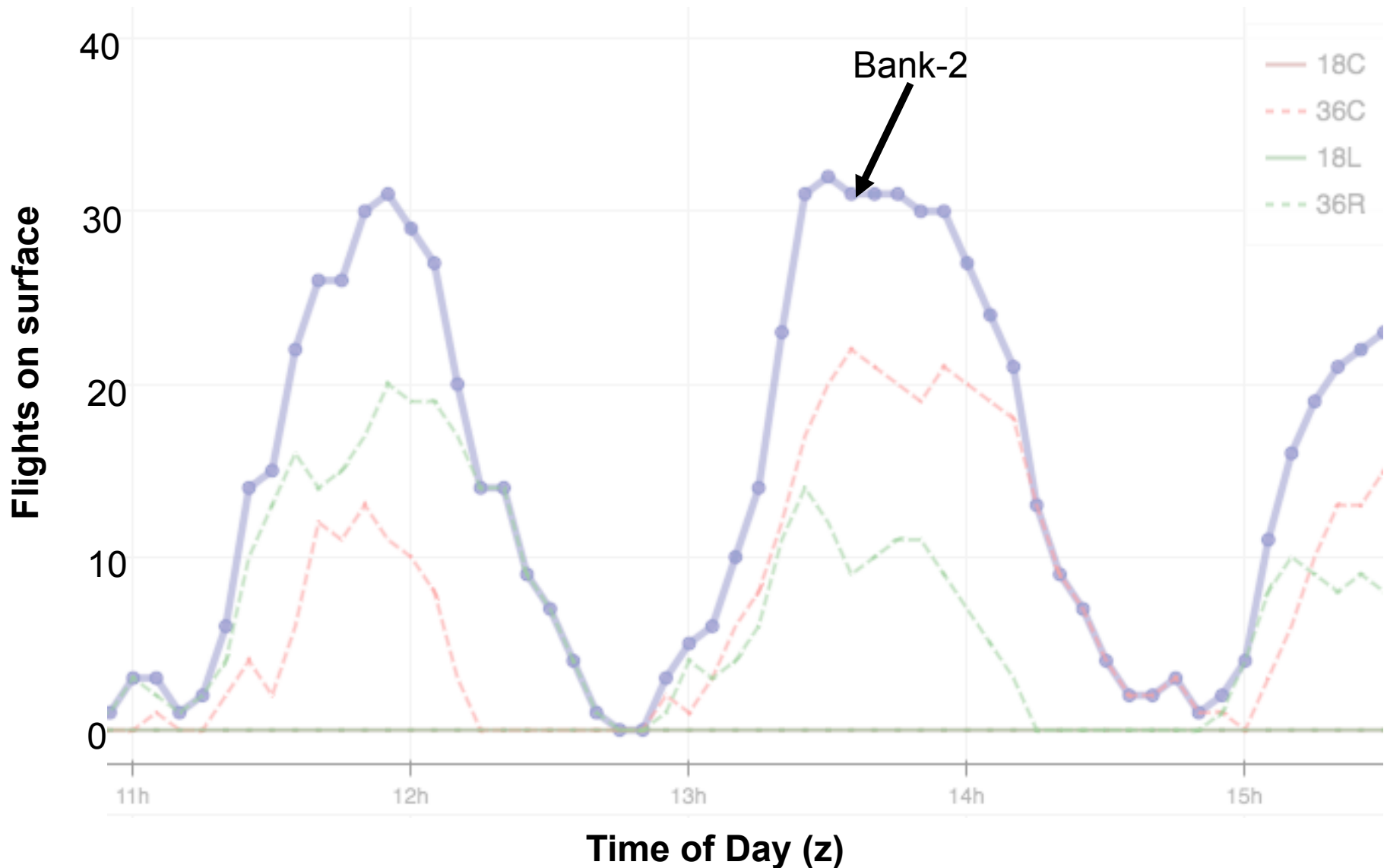
West side
Arrivals




TRACON estimated to start offloading flights to 18C here, which lowers 18C departure rate for the remainder of the departure push

TRACON scratchpad entries are helpful for arrival runways, but only about 12-15 minutes prior to landing

- Runway utilization intent from ATC is used by the tactical scheduler to determine the capacity for a bank
- Information used in tactical scheduler capacity estimate
 - Use of converging runway
 - Arrival crossings
 - Mixed/dual use runways
 - Meteorological conditions (IMC, VMC)
 - Flight separation rules (wake vortex, departure fix)
 - Flights subject to FAA restriction (MIT, EDCT, APREQ)
 - Runway and taxiway outages
 - Arrival ON time and runway information from R-TBFM



- 
- Feb 22 & 23 – Shadow 7 - CLT pilot engagement
 - Week of Mar 5th – HITL at NASA Ames leading to FRZ1
 - Week of Mar 20 – Shadow Area Q&A at CLT leading to FRZ1
 - Mar 28 – Open lab (all day)
 - Mar 29 – Demonstration Requirements Freeze (FRZ1)
 - Apr 25-27 – Engineering Shadow Evaluation 1 (ESE1) - A
 - May 30-June 1 – ESE1 - B
 - June 27-29- ESE1 – C and OSE1 readiness decision
 - July-Sept Operational Shadow Evaluation 1 (OSE1)



PH1 Capability



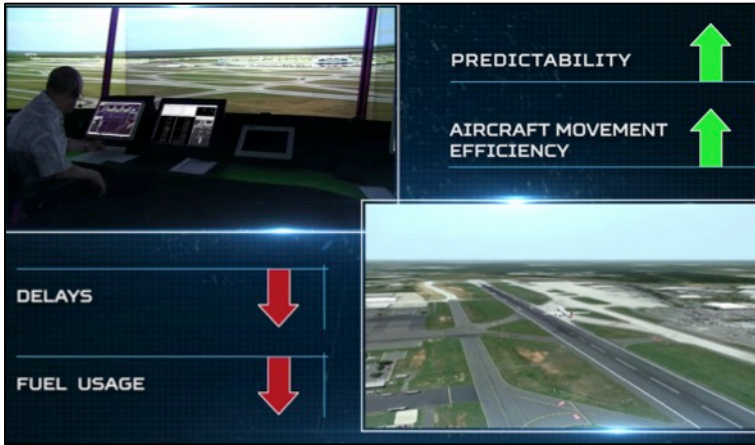
PH1 Maturity

Time	Event	Presenter
0800	Opening Remarks and Introductions	Shawn Engelland
0830	ATD-2 Background and Context	Al Capps
0915	Current Operations and ATD-2 Solutions Primer	Becky Hooey
1000	Break	Break
1015	Phase 1 Procedures, Training expectations	Becky Hooey
1200	Lunch	Lunch
1300	Phase 1 Procedures, Training expectations (cont.)	Becky Hooey
1430	Future Opportunities to Engage. Q&A	Al Capps
1445	Break	Break
1500	Research on Integrated Mobile Technology	FAA/MITRE

What does ATD-2 mean for Pilots?

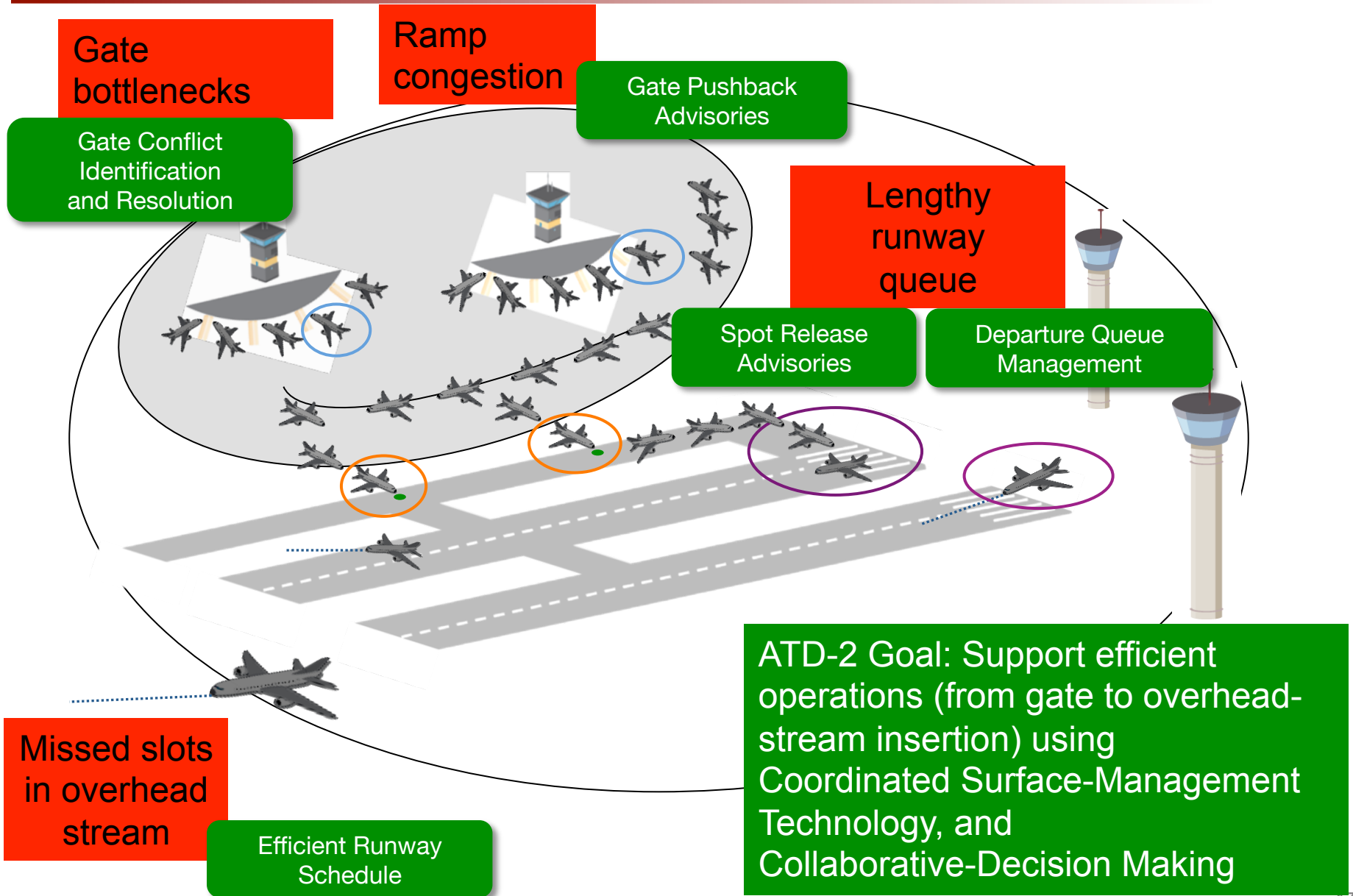


Goals of ATD-2



Our goal is to minimize pilot procedural changes while maximizing benefits for pilots. To do this, we need your input:

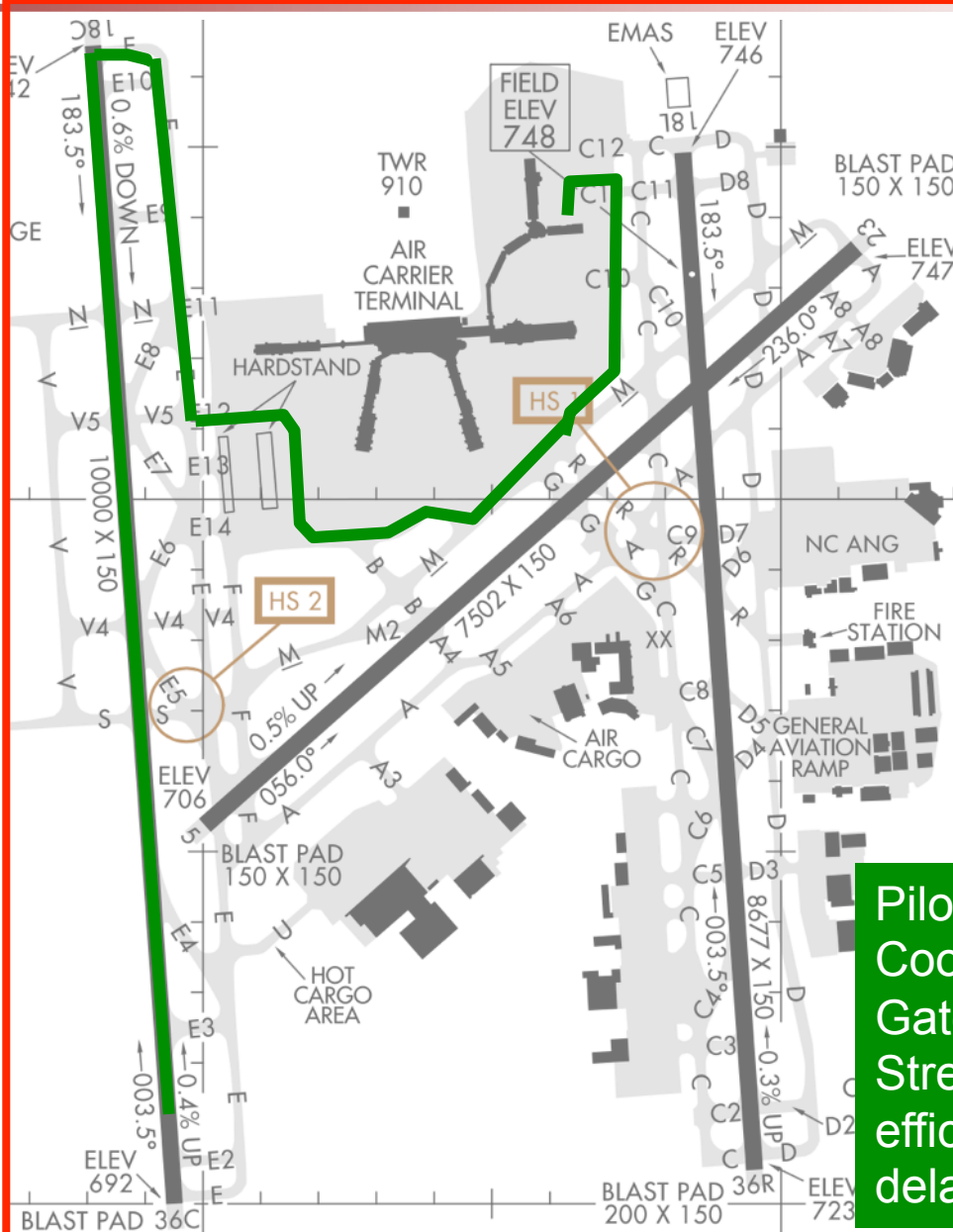
- How will ATD-2 affect your procedures?
- What training will pilots need?
- What information do pilots need; when and how?
- How can pilots help support the overall goals of ATD-2?



Increased System Efficiency: What does it mean for Pilots?

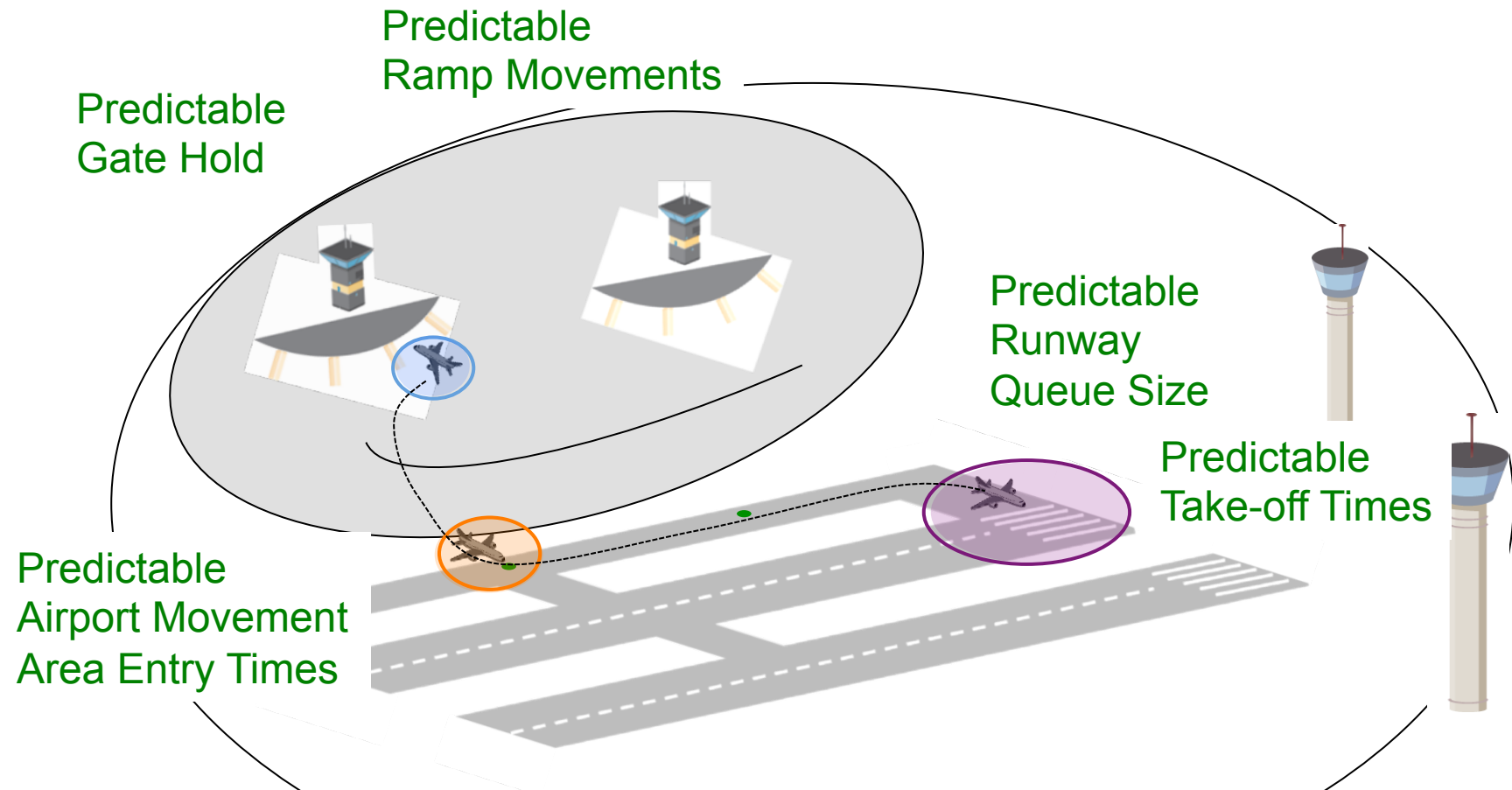


- Earlier identification of gate conflicts
- Hold at gate rather than at runway; Shorter runway queues
- Less stop-and-go taxi
- Conformance to ATC-issued take-off times to meet flow control



Pilot Benefit:
Coordinated transit from Gate to Overhead Stream for more efficient taxi with less delay

Goal: Increase Predictability



ATD-2 Goal:

- Provide accurate and reliable estimates of gate hold times.
- Provide predictable take-off times and queues

Increased Predictability: What does it mean for Pilots?



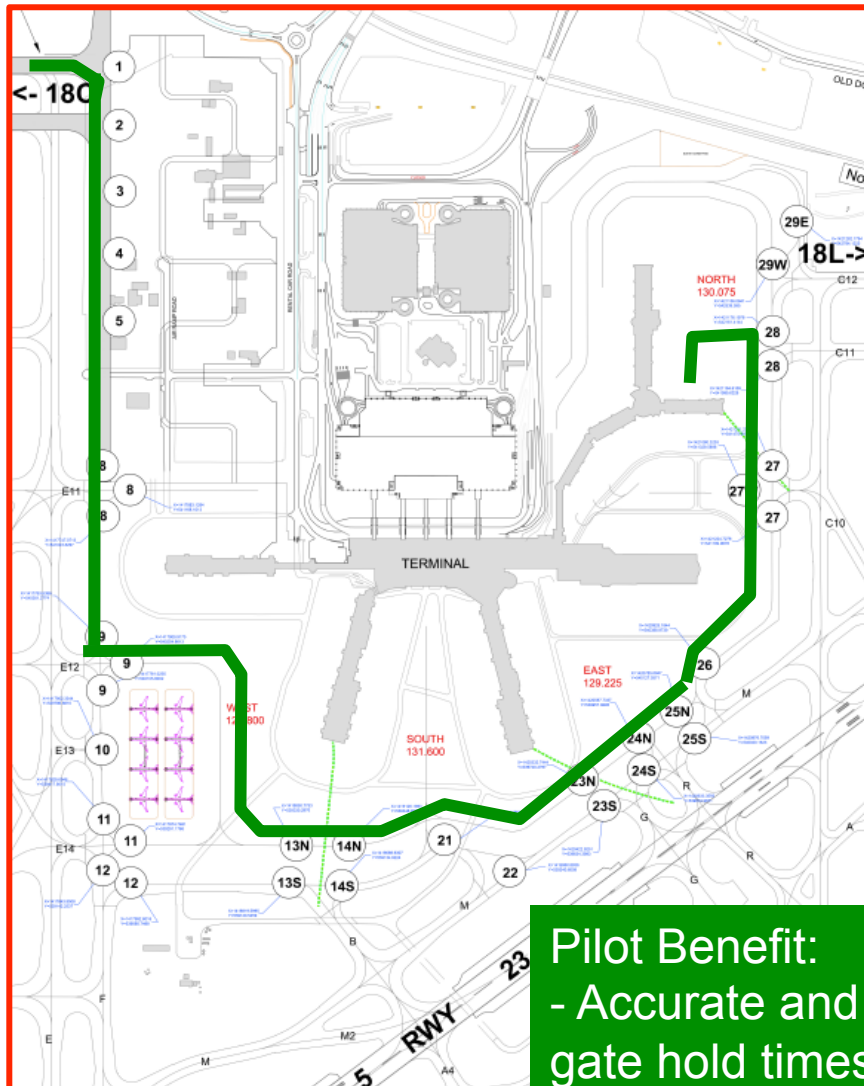
Manage work flow:

- Start 2nd engine
- Cabin preparation
- Checklists

Manage delay; Deciding when to:

- Board passengers
- Add fuel
- Push or wait at gate with engines off

Managing Passenger Expectations

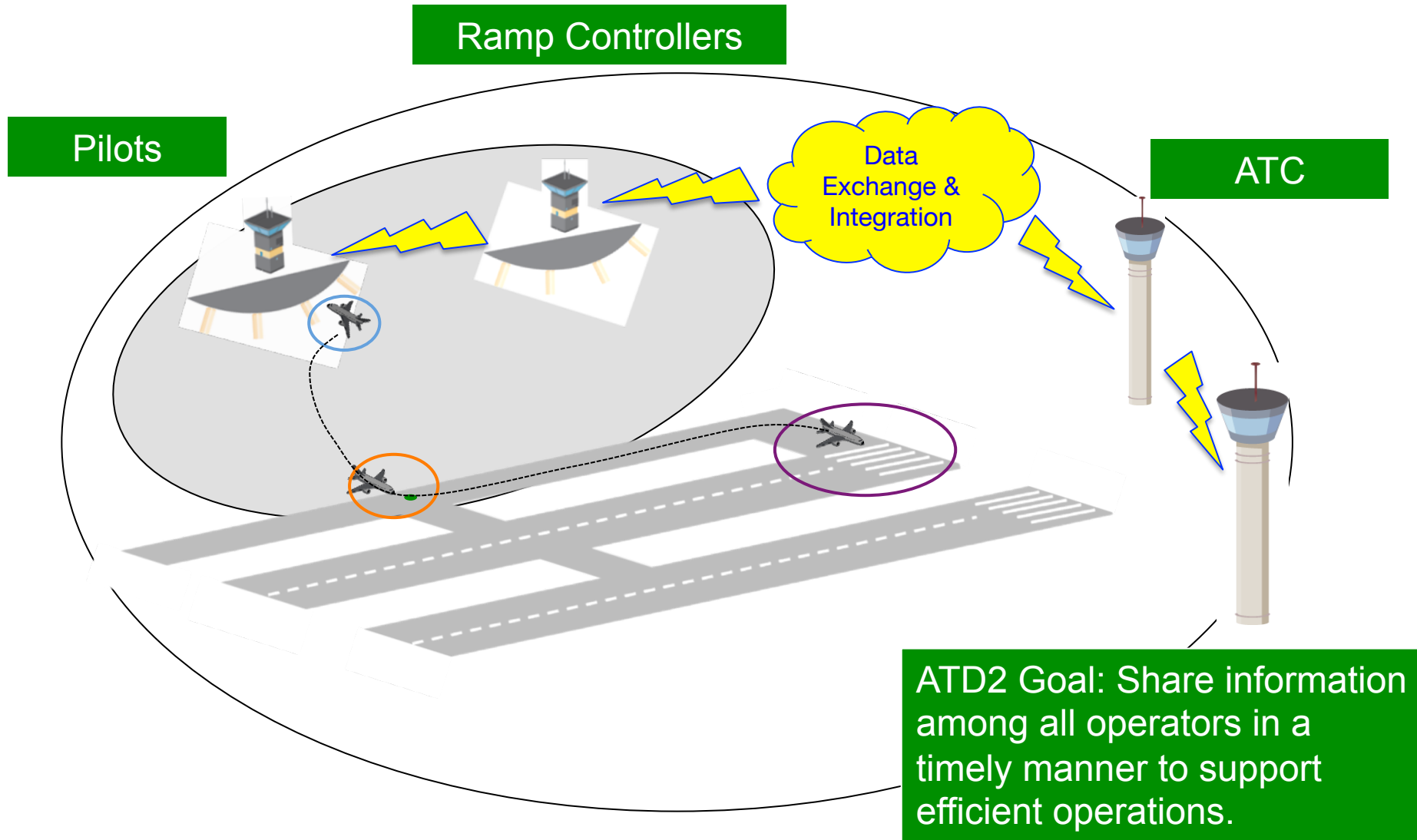


Manage time constraints:

- Wheels-Up times
- Long-on-board times
- Crew-duty times

Pilot Benefit:

- Accurate and reliable estimates of gate hold times and delay
- Take the guess-work out of meeting EDCT and wheels-up times



Early and Accurate Information: What does it mean for Pilots?

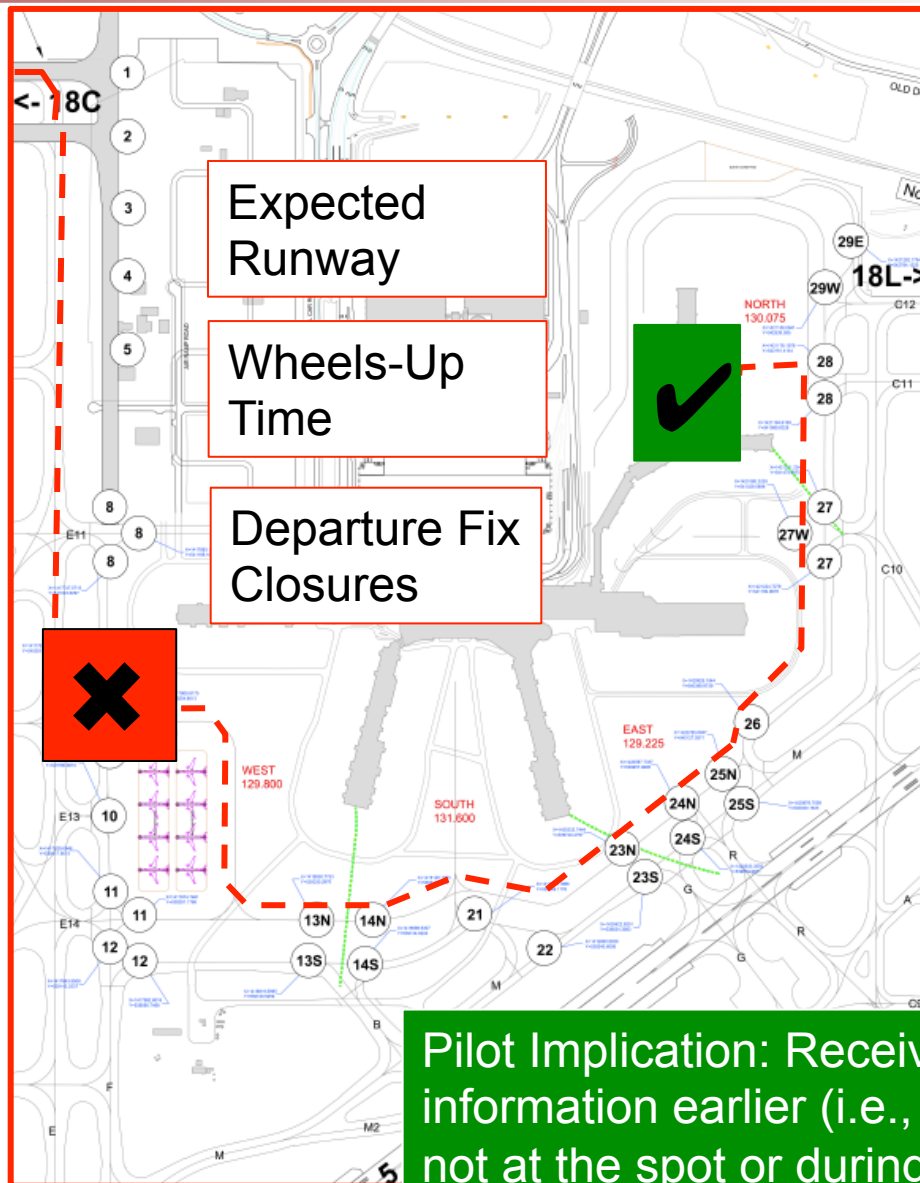


Improved Safety

- Reduce pilot workload during taxi
- Reduce eyes-in time

Improved Efficiency

- Reduce possibility of arriving at departure runway before ready to take-off



Pilot Implication: Receive accurate information earlier (i.e., at the gate, not at the spot or during taxi).

Time	Event	Presenter
0800	Opening Remarks and Introductions	Shawn Engelland
0830	ATD-2 Background and Context	Al Capps
0915	Current Operations and ATD-2 Solutions Primer	Becky Hooey
1000	Break	Break
1015	Phase 1 Procedures, Training expectations	Becky Hooey
1200	Lunch	Lunch
1300	Phase 1 Procedures, Training expectations (cont.)	Becky Hooey
1430	Future Opportunities to Engage. Q&A	Al Capps
1445	Break	Break
1500	Research on Integrated Mobile Technology	FAA/MITRE



1. Communicating Expected Runway

2. Surface Metering

3. Tactical Flow Control / Wheels-Up Time (APREQ/CFR)

4. Expect Departure Clearance Time (EDCT)

5. Departure Fix Closures

Runway Assignment

Communicating earlier and more consistently:

- Expected runway assignment,
- Specification of runway for operational necessity,
- Runway requests for convenience / efficiency

TODAY	ATD-2 PLAN	PROCEDURE CHANGE	
<p>Pilots learn about their runway assignment in a variety of ways:</p> <ul style="list-style-type: none"> a. Knowledge of KCLT ops b. Ramp Control c. Ground Control 	<ul style="list-style-type: none"> • Ramp will be equipped with ATC's planned runway assignment • Expected runway will be incorporated in pushback clearance phraseology 	Pilot	No
		Ramp	Yes
		ATC	Yes

What does it mean for pilots?

Early and Accurate Information: Pilots will know their runway earlier, allowing more time to prepare for departure.

Airline transmits
EOBT to ATD-2
Scheduler

ATD Scheduler
generates
TTOT, TMAT,
and TOBT

Push-30

Scheduled
Pushback Time

Ramp Traffic Console

Receive
Departure
Clearance

Call Ramp
when ready to
pushback

AAL705 A321 E
BOBZY-SFO
CG 9 18C P1856

Pushback
without
delay

Ramp:
Cleared to Push
Expect Rwy 18C

EOBT = Earliest Off Block time (Aircraft Ready Time)

TTOT = Target Take-Off Time

TMAT = Target Movement Area Time (Release from Spot onto Airport Movement Area)

TOBT = Target Off-Block Time (Pushback)

	TODAY	ATD-2 PLAN	PROCEDURE CHANGE	
Operational Necessity	Pilots may specify need to Ramp or Ground Control. If ramp, Ramp communicates need to ATC.	Pilots should specify Operational Necessity to Ramp while at gate. Ramp will electronically communicate need to ATC.	Pilot	Yes
			Ramp	Yes
			ATC	Yes

What does it mean for pilots?

Early and Accurate Information: Pilots will know their runway earlier (at gate), allowing more time to prepare for departure.

Better Efficiency: Early runway requests can be scheduled earlier and more efficiently.

Airline transmits
EOBT to ATD-2
Scheduler

ATD Scheduler
generates
TTOT, TMat,
and TOBT

Push-30

As soon as
known

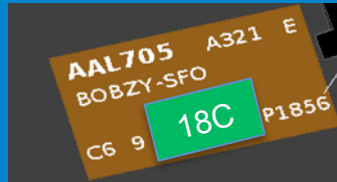
Ramp Traffic Console

Scheduled
Pushback
Time

Ramp Traffic Console

Receive
Departure
Clearance

Contact
Ramp to
specify Op.
Necessity



Call Ramp
when
ready to
pushback



Pushback
without
delay

Ramp Controller
inputs runway to
update ATD-2
scheduler

Ramp:
Cleared to Push,
Expect Rwy 18C

Surface Metering

Gate-hold metering may be applied when traffic demand exceeds runway capacity

TODAY	ATD-2 PLAN	PROCEDURE CHANGE	
<ul style="list-style-type: none"> In previous surface metering programs at KCLT, gate holds began when the number of aircraft at runway queue surpassed a static value. 	<ul style="list-style-type: none"> Predictive (Time-based metering) algorithms will consider a number of variables targeted at operational efficiency Ramp will be equipped with pushback advisories for each aircraft: Push or Hold for 'x' minutes. 	Pilot	Yes
		Ramp	Yes
		ATC	No

What does it mean for pilots?

Better Predictability: The length of the gate hold will be known and reliable. Runway queue will be shorter and more predictable.

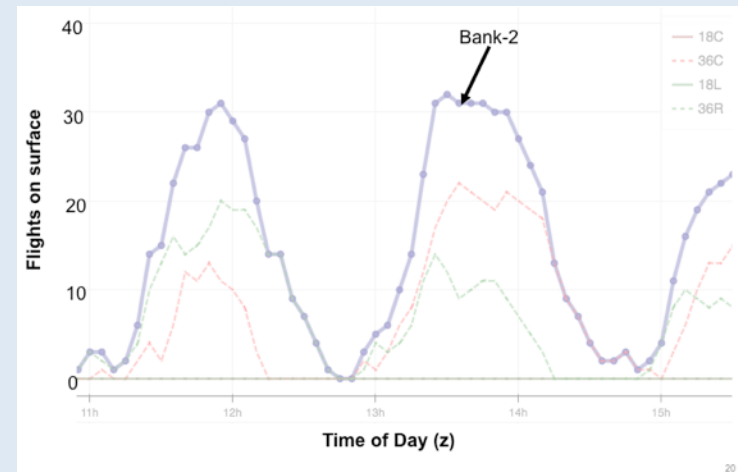
Better Efficiency: Delay will be taken at the gate, when possible, instead of at the runway. Less congestion in the ramp and AMA, reduced runway queue, reduced fuel burn and emissions.

What is it?

The ramp controller will be using pushback advisories to release aircraft from the gate. The pushback advisory indicates either immediate pushback or gate-hold with a hold time.

Which flights will be affected?

- In Phase 1, surface metering will begin in Bank 2 (~ 8:30 a.m. to 10:00 a.m.), this may expand to other banks.
- All flights that do not have EDCT or Flow Control times will be subject to Metering. (No double delay)
- Approximately 50% of the flights will receive gate holds



How will Pilot Procedures Change?

- There is no change in how/when pilots initiate contact with ramp control for pushback
- If ramp clears the flight to pushback, flight proceeds as normal
- If ramp issues a gate hold, remain at gate and contact ramp again at the specified time for immediate pushback

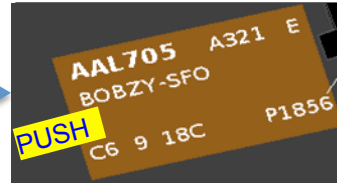
Surface Metering: Phase 1



Airline transmits
EOBT to ATD-2
Scheduler

ATD Scheduler
generates TTOT,
TMAT, and
TOBT

Ramp Traffic Console



Pushback
without
delay

Push-30

Scheduled
Pushback
Time

No
Gate
Hold

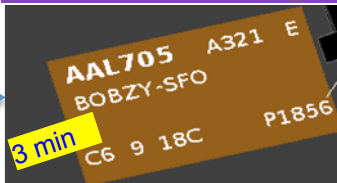
Ramp:
Cleared to Push,
Expect Rwy 18C

Receive
Departure
Clearance

Call Ramp
when
ready to
pushback

Gate
Hold

Ramp Traffic Console



Wait 3
minutes Call
Ramp

Ramp: Gate-Hold
3 minutes *

Ramp Traffic Console



Pushback
without
delay

Ramp:
Cleared to Push,
Expect Rwy 18C

* 3 minute hold is an
example only

Tactical Flow Control (APREQ/CFR)

Controlled Take-Off Times are negotiated between ATC and Center to slot aircraft into the overhead stream.

Typically negotiated close to departure time (~ 10 minutes)

ATC's goal is to depart aircraft within a -2 minute / + 1 minute window

TODAY	ATD-2 PLAN	PROCEDURE CHANGE	
Ramp Control is unaware of wheels-up times.	Flow control restrictions will be negotiated between ATC and Center and electronically communicated to Ramp.	Pilot Ramp ATC	TBD Yes No
No tools are available to help ramp / pilots meet wheels-up time.	Ramp control tools will support pushback coordination and flight prioritization.		
Pilots are often unaware that they have a wheels-up time until AMA spot	These flights will not be subject to surface metering to avoid double delay.		

What does it mean for pilots?

Early and Accurate Information: Pilots will know the wheels-up time at gate, before pushback.

Better Predictability: Ramp will know when to push aircraft in order to meet wheels-up time.

Better Efficiency: Delay can be taken at the gate, when possible, instead of at the runway. Improved scheduling into overhead stream.

Tactical Flow Control (APREQ/CFR): Phase 1



Airline transmits
EOBT to ATD-2
Scheduler

ATC and Center
negotiate
Controlled Take-
Off Time (CTOT)

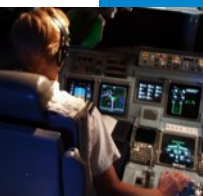
ATD Scheduler
generates TMAT,
and TOBT to meet
CTOT

Push
-30 min

Pushback

Ramp Traffic Console

Ramp Traffic Console



Receive
Departure
Clearance
with Expect
Flow Control

Contact
CD for
Wheels-
Up Time



Call Ramp
when
ready to
pushback



Pushback
without
delay

CD:
Wheels-
Up Time
2100

Ramp Console
displays Wheels-
Up Time (2100)

Ramp:

- Cleared to Pushback
- Expect Rwy 18C
- ATC-Advised Wheels-
Up Time of 2100

Expect Departure Clearance Time (EDCT)

EDCT is the runway release time (“Wheels Up”) assigned to aircraft due to Traffic Management Initiatives (TMIs) that require holding aircraft on the ground at the departure airport.

EDCT's are typically known at least 30 minutes in advance, and are included in the PDC.

ATC's goal is to depart aircraft within a -5 minutes / + 5 minute window

TODAY	ATD-2 PLAN	PROCEDURE CHANGE	
<ul style="list-style-type: none"> Pilots receive EDCT from company, CD, or PDC. 	<ul style="list-style-type: none"> No change 	Pilot	No
<ul style="list-style-type: none"> Pilots estimate when to push to meet EDCT based on traffic congestion etc. 	<ul style="list-style-type: none"> Ramp will be equipped with tools and pushback advisories to enable EDCT conformance. 	Ramp	No
<ul style="list-style-type: none"> Dispatch, ramp, ATC, CD, don't always have the same EDCT times 	<ul style="list-style-type: none"> Ramp, and ATC share the same current EDCT information. 	ATC	No
	<ul style="list-style-type: none"> EDCT flights are not subject to surface metering 		

What does it mean for pilots?

Better Predictability: Pilots will know when to pushback in order to meet EDCT time. Delay can be taken at the gate, when possible, instead of at the runway.

EDCT: Phase 1



Airlines transmit
EOBT to ATD-2
Scheduler

EDCTs generated
as per current
operations

ATD Scheduler
generates
TMAT, and
TOBT to meet
CTOT

Pushback

Ramp Traffic Console



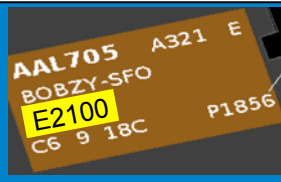
Pushback
without
delay

Ramp: Cleared to
Push, expect Rwy
18C

Ramp Traffic Console

Receive
Departure
Clearance
with EDCT

Call Ramp
when
ready to
pushback



Hard-
stand



Pushback,
Taxi to
Hardstand



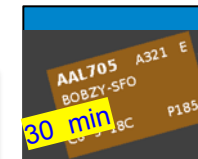
Monitor
Ramp for
release

Ramp Console
displays EDCT
(2100)

Ramp: Cleared
to Push, Taxi to
hardstand

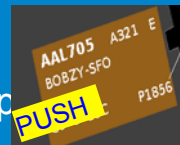
Ramp tools manage
hardstand release
time

Gate Hold



Wait 30
minutes

Call
Ramp

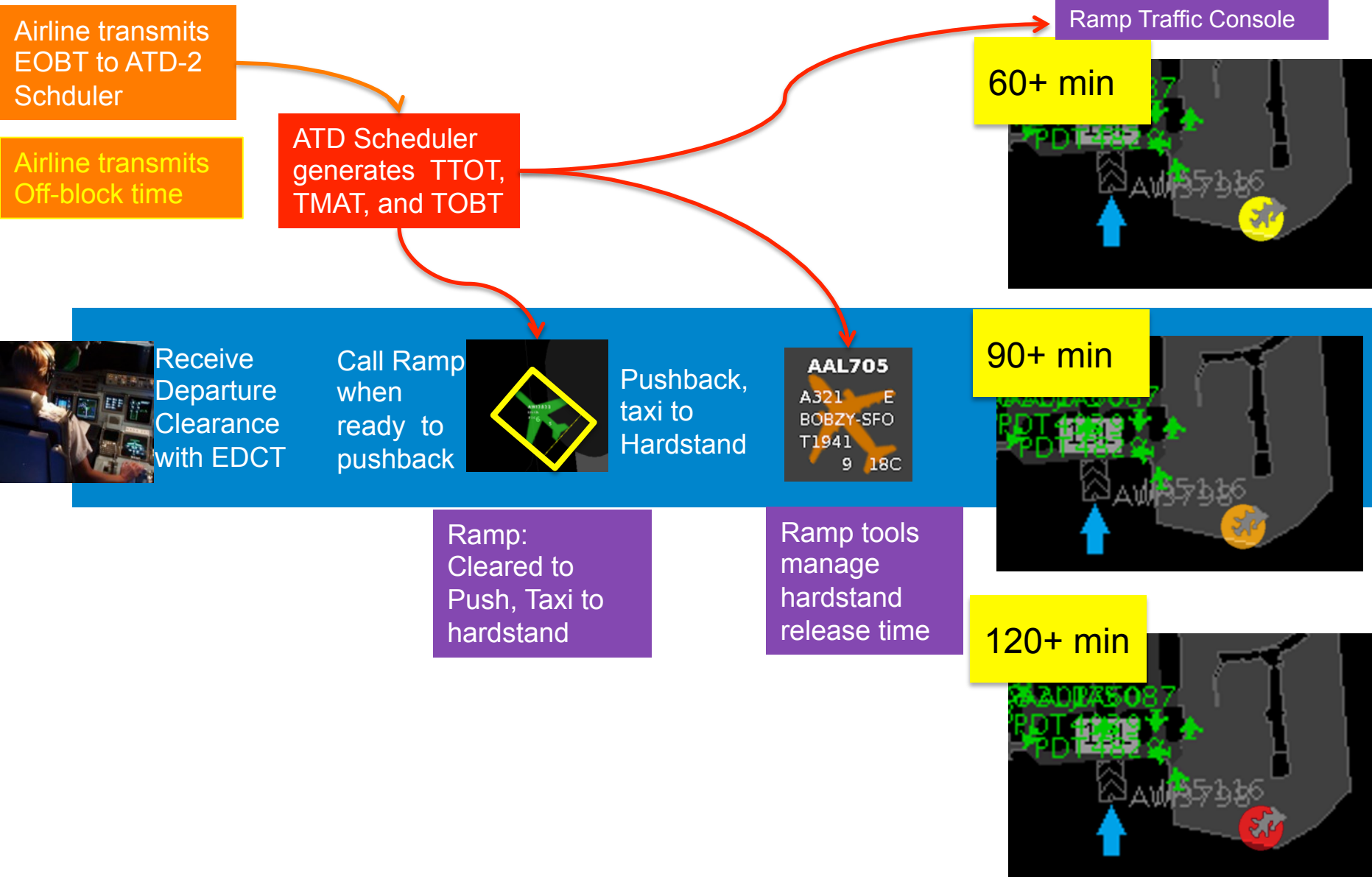


Push
without
delay

Ramp: Gate-Hold
30 minutes*

Ramp: Clear to Push,
expect Rwy 18C

* example only



Departure Fix / Route Amendments

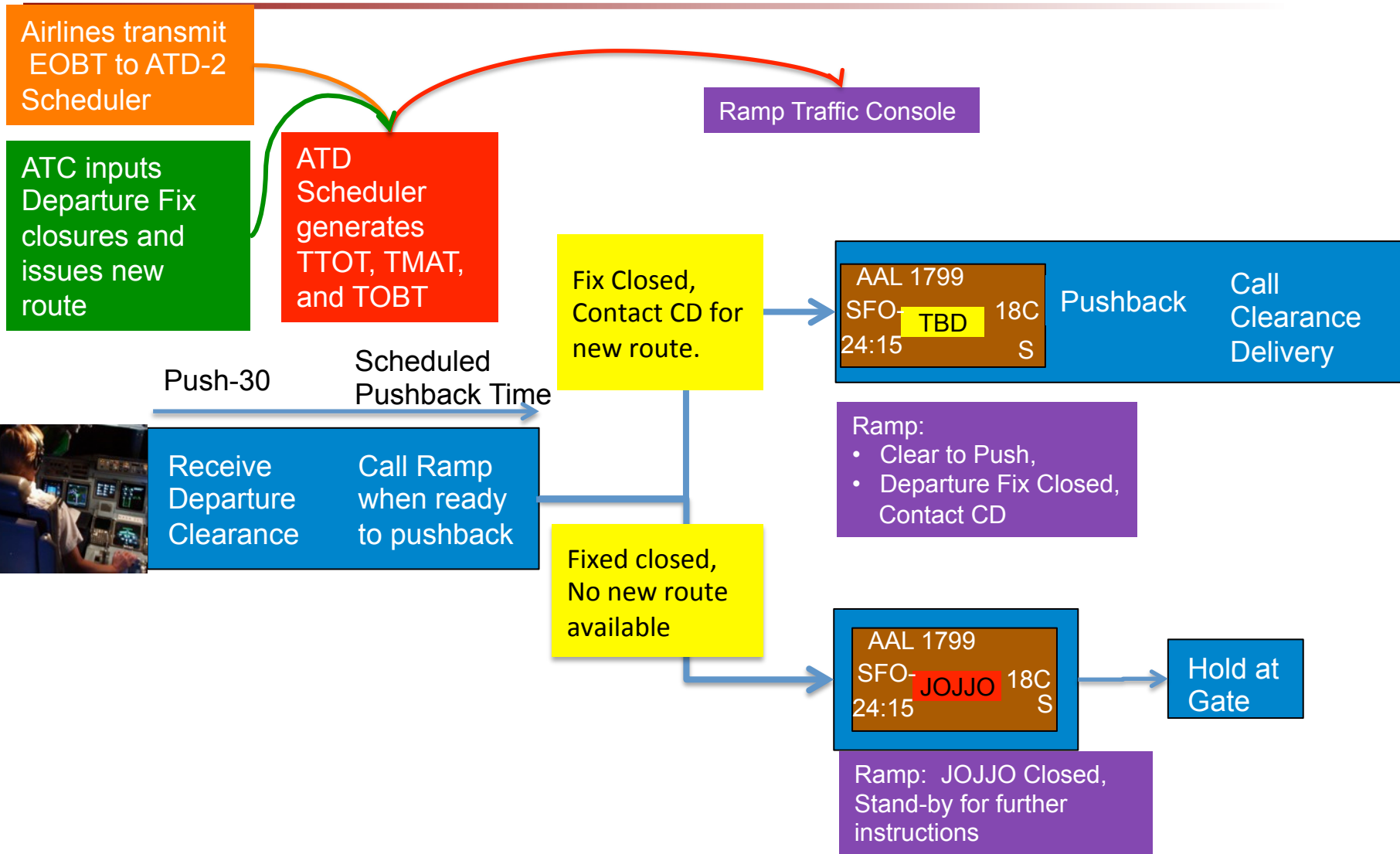
Departure Fixes may be closed or combined due to weather. This frequently occurs with short notice and therefore may require a change to the previously issued departure clearance.

TODAY	ATD-2 PLAN	PROCEDURE CHANGE	
<p>Departure fix closures are typically communicated to pilots by Ground Control, at the spot.</p> <p>Ramp Control can also communicate departure fix closures, when able.</p>	<ul style="list-style-type: none"> Ramp will be equipped with Departure Fix Closure information Ramp Control will communicate to pilots when departure fixes are closed and instruct pilots to contact CD 	Pilot	Yes
		Ramp	Yes
		ATC	No

What does it mean for pilots?

Early and Accurate Information: Pilots will know their departure route earlier, allowing more time to communicate with dispatch/clearance delivery and/or prepare for departure.

Departure Fix Change: Phase 1



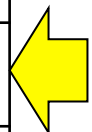
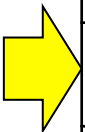
Phase 1 Pilot Training Needs: Starting the Discussion




Phase 1 Changes	
1. Runway Assignment	<ul style="list-style-type: none"> - Expected runway will be provided by Ramp - Pilot should specify operational necessity before pushback
2. Surface Metering	<ul style="list-style-type: none"> - Expect gate holds when Surface Metering is on - Contact ramp promptly - Push without delay when cleared
3. Tactical Flow Control Wheels-Up Times	<ul style="list-style-type: none"> - Contact CD for wheels-up time - Contact ramp and pushback promptly
4. EDCT	<ul style="list-style-type: none"> - Ramp will coordinate pushback to meet EDCT, - Aircraft will remain at gate, unless gate conflict.
5. Departure Fix Closures	<ul style="list-style-type: none"> - Fix closures will be communicated by Ramp - Flight will be held at gate if route not available, unless gate conflict

Data Type	Data Element	From Pilot/Airline	To Pilot
Runway Assignment	Expected Runway Assignment		•
	Operational Necessity Specification	•	
	Taxi for Convenience Request; on/off		
Airport Configuration	Runway Utilization / Flow Direction		
	Departure fix closed/combined		•
Aircraft/ Flight	Long-on-board time	•	
	Crew duty time		
Surface Metering	Surface Metering on/off		
	Earliest Off Block Time (EOBT), Flight Ready time	•	
	Target Off Block time (TOBT), Pushback time		
	Target Movement Area Time (TMAT), Spot Release		
	Target Take-Off Time (TTOT), Departure Clearance		
Controlled Take-Off Times	Expected Departure Clearance Time (EDCT)		•
	Flow Control Wheels-Up time (APREQ / CFR)		•
	Miles In Trail (MIT)		

Time	Event	Presenter
0800	Opening Remarks and Introductions	Shawn Engelland
0830	ATD-2 Background and Context	Al Capps
0915	Current Operations and ATD-2 Solutions Primer	Becky Hooey
1000	Break	Break
1015	Phase 1 Procedures, Training expectations	Becky Hooey
1200	Lunch	Lunch
1300	Phase 1 Procedures, Training expectations (cont.)	Becky Hooey
1430	Future Opportunities to Engage, Q&A	Al Capps
1445	Break	Break
1500	Research on Integrated Mobile Technology	FAA/MITRE



- 
- Feb 22 & 23 – Shadow 7 - CLT pilot engagement
 - Week of Mar 5th – HITL at NASA Ames leading to FRZ1
 - Week of Mar 20 – Shadow Area Q&A at CLT leading to FRZ1
 - Mar 28 – Open lab (all day)
 - Mar 29 – Demonstration Requirements Freeze (FRZ1)
 - Apr 25-27 – Engineering Shadow Evaluation 1 (ESE1) - A
 - May 30-June 1 – ESE1 - B
 - June 27-29- ESE1 – C and OSE1 readiness decision
 - July-Sept Operational Shadow Evaluation 1 (OSE1)

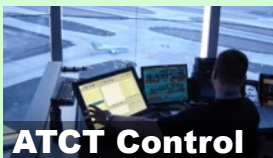


PH1 Capability



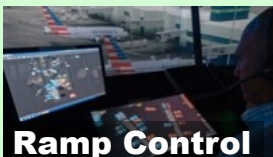
PH1 Maturity

- Backup



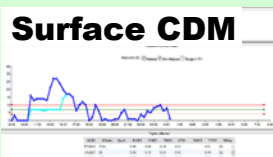
ATCT Control

- TFDM EFD is controller interface to ATD-2 scheduling and metering
- Better predictability improves TMI compliance



Ramp Control

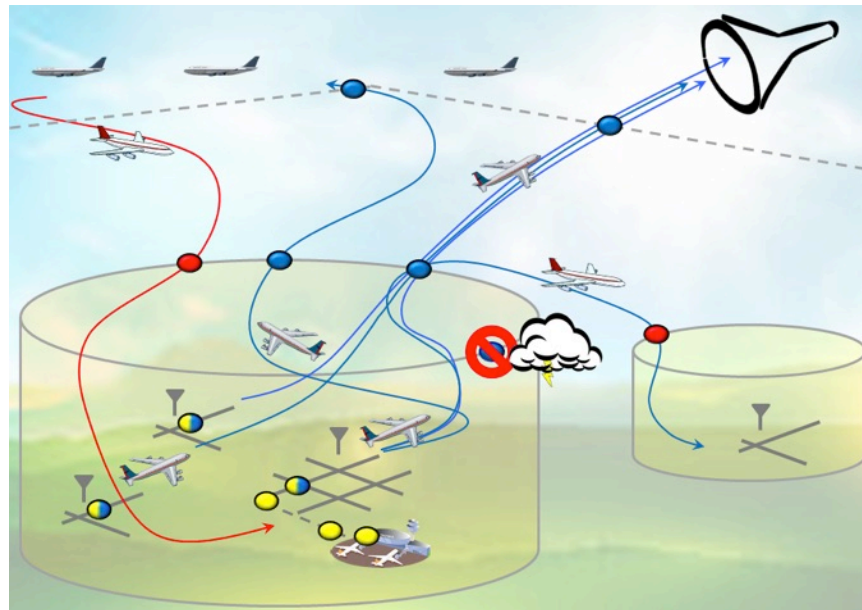
- Tactical pushback advisories build on SARDA research
- Manage ramp traffic and meet strategic TMATs
- Ramp and gate status and intent information



Surface CDM

- Builds on Surface CDM concept engineering effort
- Identify need to meter and compute ration-by-schedule strategic TMATs
- Accommodate airline priorities

Surface Components



ATCT TMU

- Tactical departure scheduling builds on IDAC and PDRC
- Manage traffic to satisfy TMIs and departure metering



ARTCC

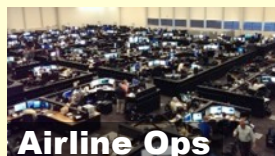
- Integrate TBFM/IDAC with ATD-2 surface system
- Improve TBFM departure trajectory predictions
- Departures into overhead and metered arrival streams



TRACON

- Local TMIs and demand predictions for all airports
- Metroplex coordination and planning functions
- Explore departure controller advisory requirements

Airspace Components



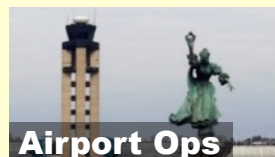
Airline Ops

- Earliest off block times
- Airline priorities via CDM
- Flight data



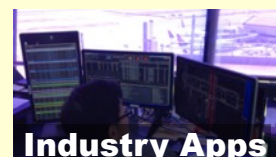
ATCSCC

- Strategic TMIs
- Surface delays
- Multi-center coordination



Airport Ops

- Airport conditions
- Additional flight operators

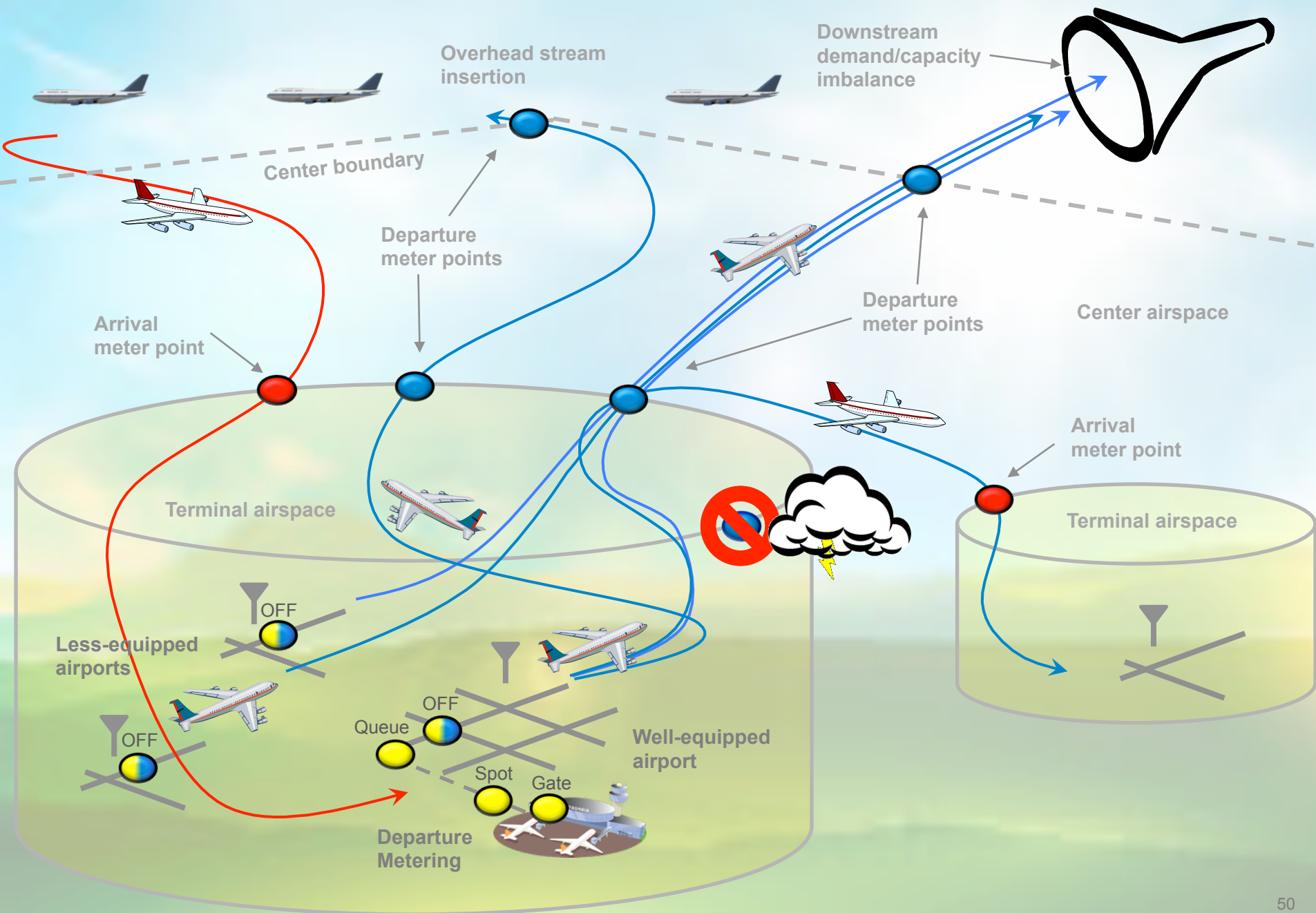


Industry Apps

- Information exchange with commercial applications

External interfaces via SWIM and SWIM extensions

Operational Environment for the ATD-2 Concept



ATD-2 combines existing and emerging FAA technologies with technologies developed through NASA research to create an Integrated Arrival/Departure/Surface (IADS) traffic management system for the metroplex.

